SUBMISSION INSTRUCTION NO. 10
LEACHATE MANAGEMENT PLAN
FOR SOLID WASTE DISPOSAL FACILITIES

Developed by:

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Office of Waste Permitting and Compliance
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I. LEACHATE MANAGEMENT PLAN [§130.L., 140.A.6., and 210, 9 VAC 20-81-10] The Leachate Management Plan should be submitted with the Part B Application or Part B Modification Application as Attachment VIII to DEQ Form SW PTB.

Format The format used for the Leachate Management Plan should encourage clear analysis and presentation of the proposed leachate management activities relating to collection, removal, treatment, and disposal. The Leachate Management Plan should start with a title page and table of contents followed by the following sections and discussions. The title page should identify the facility name and permit number, the permit applicant, document date, and document preparer information. In addition, the header or footer of each page should include the facility name, permit number, document title, revision date, and page number.

Leachate collection systems for solid waste disposal facilities are typically designed to include one or more drainage layers, a series of perforated leachate collection pipes, and a protective filter layer. Collected leachate is then removed through sumps or gravity drain carrier pipes to one or more tanks or surface impoundments/lagoons, before being disposed. Information on the proposed leachate management system to be installed and operated at the proposed solid waste disposal facility should be presented in this plan.

Leachate collection systems for solid waste management facilities may or may not be required depending on the design and operation of the proposed management facility. If the proposed solid waste management facility will collect, store, treat, and dispose of its leachate, information on the proposed leachate management system to be installed and operated at the proposed solid waste management facility should be presented in this plan, as applicable.

A. ***Leachate Estimate*** [§ 210.A.1., 9 VAC 20-81-10] Estimate the quality and quantity of leachate to be generated annually by each unit, based on generally accepted methods for projection of leachate flow.[1] The estimate shall include the 30-day volume and average flow rate for each month of the year. At a minimum, annual leachate production shall be estimated at 5-year intervals for 20 years or until closure, whichever is greater. For existing facilities, include the current leachate generation rate. Describe assumptions, data sources, and methods used to perform the modeling and calculations. Provide copies of model results and calculations in an attachment to this plan.

B. ***Leachate Collection*** [§210.A.1.a., 9 VAC 20-81-10] In the following sections, provide information on the design of the proposed leachate collection system (LCS). Reference the appropriate Design Plans (PTB Attachment III) and Technical Specifications (PTB Attachment VII) as necessary.

    1. **Drainage Layer Design.** [§210.A.3., 9 VAC 20-81-10] Describe the materials to be used in the leachate collection system drainage layer.

[1] The Hydraulic Evaluation of Landfill Performance (HELP) Model

a. Soil Drainage Layer

i. *Bearing Strength.* Demonstrate that the drainage layer will have sufficient bearing strength to support expected loads.

ii. *Slope Stability.* If the landfill is designed on moderately to steeply (greater than 15%) sloping grades, include calculations demonstrating that the selected granular drainage materials will be stable on the most critical (e.g., usually the steepest) slope in the design. The calculations and assumptions shall be shown, especially the friction angles between all material interfaces, and supported by laboratory and/or field testing.

b. Geosynthetic Drainage Layers**.** Geosynthetic drainage nets (geonets and geocomposites) may be substituted for the granular layers of the leachate collection system on the sidewalls of the landfill cells. A geonet can be considered for bottom drainage use in CDD and industrial landfills. Filter materials are sometimes used above geosynthetic drainage layer. These materials can experience problems with creep, intrusion, biological clogging etc.

i. *Transmissivity.* If a geonet is used in place of a granular drainage layer, it must provide the same level of performance (maintaining less than 12 inches of leachate head above the liner). Show the calculation used to compute the capacity of a geonet and filter system. The transmissivity of a geonet can be reduced entirely by intrusion of the fine textured materials. A protective geotextile between this material and geonet is sometimes used to help alleviate this concern. Show the results of the laboratory transmissivity tests performed under loads, and configurations that closely replicate the actual field conditions. It is important that the transmissivity value used in the leachate collection system design calculations be selected based upon those loaded conditions.[2]

ii. *Creep*. Show that creep or intrusion of fines will be prevented. Specify minimum transmissivity under expected operating (dynamic) and completion (static) loads. The specifications for thickness and type of materials shall be identified on the drawings and shall be consistent with the design calculations.

iii. *Side Slopes*. Show the friction factors against sliding for geotextiles, geonets, and geomembranes. Manufacturers' data may be used, but shall be supported by the results of actual tests using site materials. Show all sliding stability calculations.

[2] Use ASTM D-4716 to evaluate the transmissivity of the geonets.

2. **Drainage Layer and Pipe Protection Design.** The openings in drainage materials, whether holes in pipes, voids in gravel, or apertures in geonets, are sometimes protected against clogging due to accumulation of fine (silt-sized) materials. An intermediate material, between the waste and drainage layer, having smaller openings than those of the drainage material, can be used as a filter. Sand or geotextiles may be used as filter material. The soil filter layer may be the uppermost layer of the LCRS; however, optionally, a buffer layer may be included to protect the filter layer from damage due to traffic. This buffer layer may be general fill, as long as it is no finer than the soil used in the filter layer. If leachate recirculation is to be included, care must be taken to ensure that the permeability of the buffer is sufficiently high. If geotextiles are used on a slope, they should be secured in an anchor trench similar to those for geomembranes or geonets. Demonstrate that the use of graded material or filter fabric system design will prevent physical clogging (sedimentation) throughout the active life of the landfill and the post-closure care period. To prevent chemical and biological clogging, show the design of a cleaning system to include:

   - A minimum of six-inch diameter pipes to facilitate cleaning;
   - A slope sufficient for self-cleaning;[3]
   - Access located at major pipe intersections or bends to allow for inspections and cleaning; and
   - Valves, ports, or other appurtenances to introduce biocides and/or cleaning solutions.

   a. Soil Filter Layer**.** Show how the design and material specifications of the filter layer will allow adequate flow of liquids through it, will provide adequate retention of fines, and evaluate the possibility of long-term clogging of the filter. Include estimates of particle size distribution of the drainage system and of the invading materials. Describe the thickness of the filter layer, the method of placement, and the dimensions of any envelope around the piping system.

   b. Geotextile Filter Layer**.** Geotextile filter design parallels sand filter design with some modifications. The most important specifications are those of hydraulic conductivity and retention. In practice, it should be noted that the use of geotextiles as filter material has resulted in problems with clogging due to biological growth on the geotextile.

3. **Leachate Collection Pipe.** The design of perforated collection pipes should consider the following factors:

   - The required flow using known percolation impingement rates and pipe spacing;
   - Pipe size using the design leachate flow (see Section I.A. of these instructions); and
   - The structural strength of the pipe.

[3] Generally, flow velocities should be in the vicinity of two feet per second.

a. Sizing**.** Demonstrate that pipe and pipe perforation sizes are sufficient to allow free leachate access to the drainage system yet avoid clogging of the perforations and pipes by the drainage media. Show all calculations.

b. Piping Strength**.** The component that is most vulnerable to strength failure is the drainage layer piping. Demonstrate that any piping used will have sufficient strength to prevent collapse from anticipated static and dynamic loads. Pipe strength calculations should include resistance to wall crushing, pipe deflection, and critical buckling pressure.

4. **LCS Design Standard** [§ 210.A.2., 9 VAC 20-81-10] Discuss the capability of the LCS to maintain less than 30 cm (12 in) of leachate above the liner system.

C. ***Leakage Monitoring System.*** [§ 210.A., 9 VAC 20-81-10] For landfills equipped with double liners, describe the design of the leak detection system and the materials of construction. Describe the layout and spacing of the pipe network.

1. **Grading.** Demonstrate that the leak detection points are appropriately located. Show that the drainage media in which the leakage monitoring system operates is appropriately graded to assure that leakage at any point in the liner system could be detected.

2. **Pipe Network.** If a pipe network is used to collect leakage, show calculations for the spacing of the pipe network.

3. **Piping Strength.** Demonstrate that any piping used between the liners will have sufficient strength to prevent collapse from anticipated static and dynamic loadings.

4. **Sizing.** Demonstrate that pipe and pipe perforation sizes are sufficient to allow free liquid access to the drainage system yet avoid clogging of the perforations and pipes by the drainage media.

5. **Drainage Media.** Demonstrate sufficient gradation of drainage media and filter materials to allow free liquid access to LMS. Demonstrate that drainage media thickness and hydraulic conductivity will be sufficient to promote drainage.

6. **Monitoring.** Demonstrate that the LMS will provide timely detection of liquids entering the space between the liners.

D. ***Leachate Removal System.*** Describe the components to be used to remove leachate from the landfill, referencing the appropriate Design Plans as necessary. If portable pumps are to be used, specify the schedule to move a pump from one sump to another in the operating plan. If gravity method is used for leachate removal, show pipe penetrations through the geomembrane and liner system and describe the construction of the penetration.

E. ***Collection and Storage Units.*** [§ 210.A.1., B. and C., 9 VAC 20-81-10] Describe the design of collection and storage facilities associated with the LCS. The design may include

berms, ditches, pumps, sumps, tanks, and surface impoundments. For planning purposes, the suggested storage volume for on-site storage of leachate is seven (7) times the peak daily value from a HELP Model simulation with one lift of waste. Describe assumptions, data sources and methods used to make the calculations.

F. ***Leachate Treatment or Disposal*.** [§ 210.D., 9 VAC 20-81-10] Describe the leachate treatment or disposal method that will be used.

G. ***Leachate Seep Management*** [§ 210.F., 9 VAC 20-81-10] Describe the facility's proposed response to a leachate seep. Actions by the facility should minimize, control or eliminate the seep in an effort to contain and properly manage the leachate at the source of the seep. In addition, provide procedures for containing leachate released outside the waste management boundary and proposed collection and disposal methods.

H. ***Attachments***

1. **Leachate Estimate Modeling Results**. Provide copies of the modeling results and any calculations used to determine the maximum quantity of leachate presented in Section I.A.

2. **Leachate Collection System Calculations.** Provide copies of calculations substantiating the information provided in Section I.B.

3. **Leakage Monitoring System Calculations.** Provide copies of calculations substantiating the information provided in Section I.C., if applicable.

4. **Leachate Collection Capacity.** Provide copies of the modeling results and calculations indicating the 7-day storage volume and capacity of the leachate storage system as indicated in Section I.E.